

ABSTRACT

A chemical reaction between molten aluminum and an oxygen carrier such as water to do useful work is disclosed, and in particular two chemical methods to obtain aluminum in its molten state. One is to detonate a HE/Al mixture with surplus Al in stoichiometry, and the other is to use an oxidizer/Al mixture with surplus Al in stoichiometry. Additionally, there is a physical method of shocking and heating Al using high temperature reaction products. The produced Al in its liquid form is forced to react with an oxygen carrying liquid (e.g. water), giving off heat and releasing hydrogen gas or other gaseous material. A water solution of some oxygen-rich chemicals (e.g. ammonium nitrate) can be advantageously used in place of water. A shaped charge is also disclosed having a liner that contains aluminum, propelled by a high explosive such as RDX or its mixture with aluminum powder. Some aluminum in its molten state is projected into the perforation and forced to react with water that also enters the perforation, creating another explosion, fracturing the crushed zone of the perforation and initializing cracks. Another shaped charge is shown having a liner of energetic material such as a mixture of aluminum powder and a metal oxide. Upon detonation, the collapsed liner carries kinetic and thermal energy. Also shown are methods to build and to detonate or fire explosive devices in an oxygen carrying liquid (e.g. water) to perforate and stimulate a hydrocarbon-bearing formation.